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VESSEL MONITORING IN THE NORTH AND BALTIC SEA CHANNELS BASED ON DUAL-POLARIZATION SAR IMAGES AND AIS DATA

Abstract

Vessel monitoring is made possible by combining information from different data sources that are generally divided in cooperative and non-cooperative sensors. In this study we will showcase the utility of coupling Synthetic Aperture Radar (SAR) images, as a source of non-cooperative data, and Automatic Identification System (AIS) data flows, as cooperative data, in analyzing the maritime traffic. SAR images occupy a privileged place in vessel monitoring due to their quasi all-weather and day/night observation capacity. The Sentinel-1 sensor acquires systematically SAR images over areas of maritime interests and presents several assets such as the open access policy data or the availability of complex dual-polarization data. The latter one can lead to the scientific research and following development of new SAR vessel detection algorithms based on dual-polarimetric features. Several research studies have shown that the fusion of polarimetric channels introduces a gain with respect to the use of single polarization image in diverse applications, including ship detection. Over areas of maritime surveillance interest, Sentinel-1 is acquiring data in the VV-VH polarization configuration. In this study we explore several polarimetric descriptors derived from the VV-VH configuration, namely the complex VV-VH coherence and descriptors derived from the Eigenvalue decomposition of the VV-VH covariance matrix, C_{VV-VH}. Several studies have assessed the use of dual polarimetric features in SAR-based ship detection. However, the corresponding experimental results rely on the analysis of certain test sites containing a reduced number of vessels.In this study we perform a complete validation of the detection performances of diverse polarimetric descriptors issued from the processing of several S1 images and the use of AIS data as ground truth. For the experimental results we will focus on Sentinel-1 Interferometric Wideswath images with a resolution of 20m, acquired over the North sea and Baltic sea areas. A particular point of interest are the channels connecting these two seas. In order to have an accurate information for the coastline in such areas, we will make use of a coastline delineation based on the bimodal distribution given by the different backscattering values of the sea and land areas. Moreover, it will be investigated how the ship detection rates are impacted by the geography of different areas of interest such as open sea, inland channels or port areas.